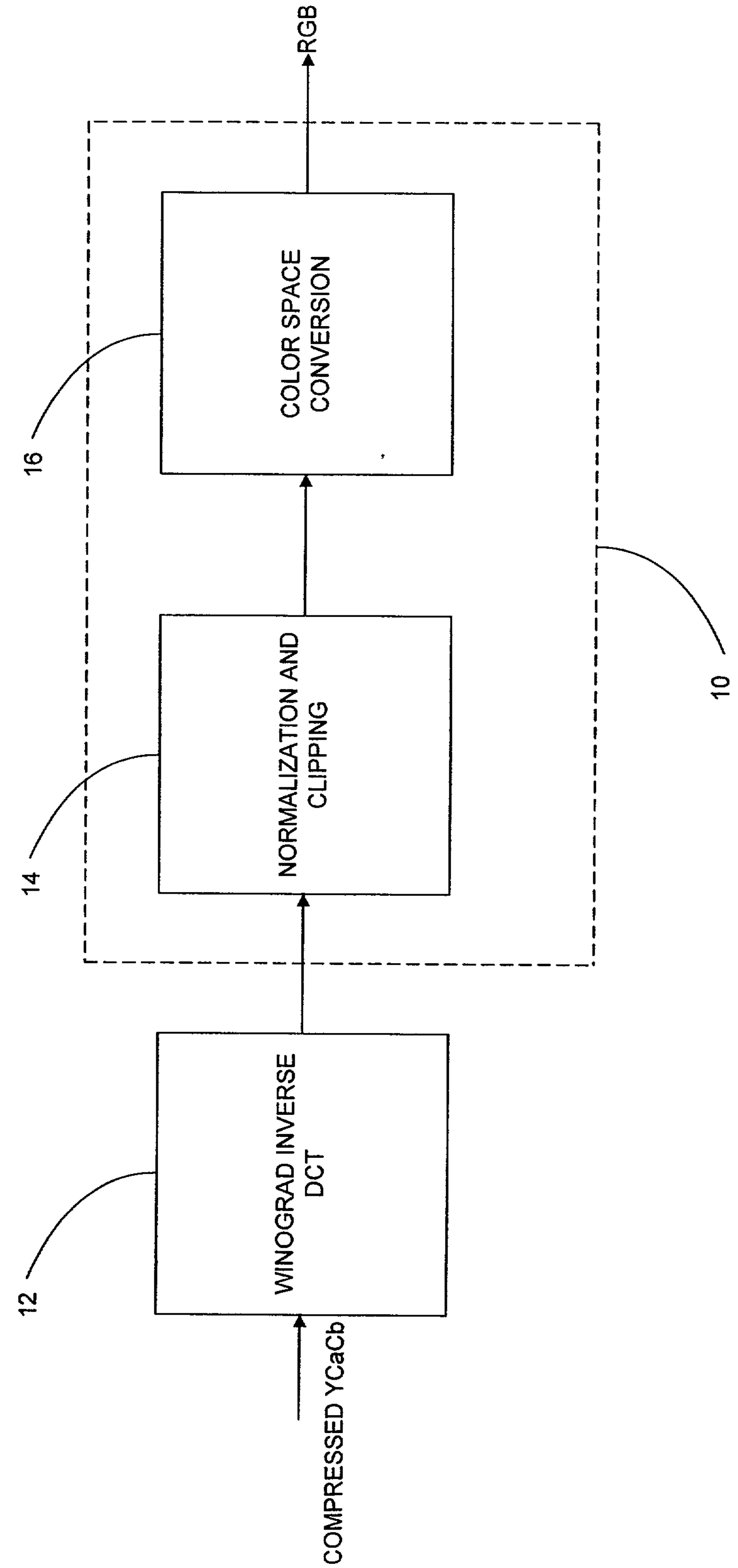
COMPRESSED YCaCb
WINOGRAD INVERSE DCT
NORMALIZATION AND CLIPPING
COLOR SPACE CONVERSION
RGB
12
14
16
10

FIG. 1

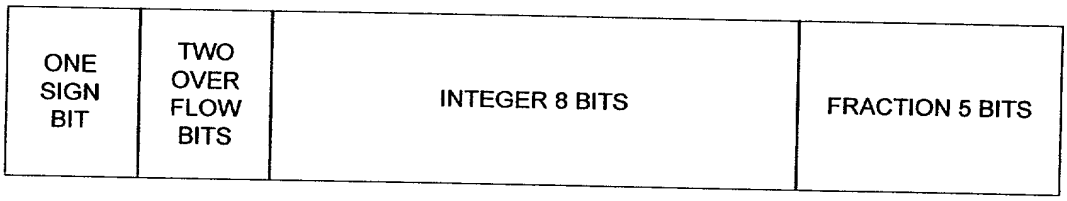
ONE SIGN BIT
TWO OVER FLOW BITS
INTEGER 8 BITS
FRACTION 5 BITS

FIG. 2A

```
// If input is not normalized, round and add 128.5 to the integer part
// with carry into the overflow and sign bits
If (~InputNormalized) NormalizedInput = input + (257 << p-1)
else NormalizedInput = input

if (NormalizedInput sign bit)
    result == 8'h00
else if (overflow bits)
    result = 8'hFF
else
    result = NormalizedInput[p+7:p]
```

FIG. 3

Bit 15: Sign bit
Bit 14:p+8: Overflow/underflow bits
Bits p+7:p: Integer part. The integer part may be normalized (0 to 255) or not normalized (-128 to +127)
Bits p-1:0: Fractional part (if p is not zero)

where p is the precision, i.e. number of bits used for the fractional part. P can be zero.

FIG. 2B

3F0_002A **CSC_M23**

Size: 9 bits
Reset Value: 0
Read/Write: R/W
Description: The M23 value
Bit(s) 8: sign
Bit(s) 7:0: magnitude

3F0_002C **CSC_M31**

Size: 9 bits
Reset Value: 0
Read/Write: R/W
Description: The M31 value (see equations)
Bit(s) 8: sign
Bit(s) 7:0: magnitude

3F0_002E **CSC_M32**

Size: 9 bits
Reset Value: 0
Read/Write: R/W
Description: The M32 value (see equations)
Bit(s) 8: sign
Bit(s) 7:0: magnitude

3F0_0001 **CSC_CONFIG**

Size: 4 bits
Reset Value: 0
Read/Write: R/W
Description: Configuration register. Writing to this register also resets the Timeout Occurred status bit.
Bit(s) 2:0: Input precision
Bit(s) 3: Input already normalized

FIG. 4A

3F0_0002 **CSC_STATUS**

Size:	word
Reset Value:	N/A
Read/Write:	Read only
Description:	Contains status information. Note: Timeout occurred status is reset by writing to the CSC_CONFIG register.
Bit(s) 15:	Timeout Occurred
Bit(s) 5:	R data ready to be read
Bit(s) 4:	G data ready to be read
Bit(s) 3:	B data ready to be read
Bit(s) 2:	Ca data waiting to be processed
Bit(s) 1:	Cb data waiting to be processed
Bit(s) 0:	Y data waiting to be processed

3F0_0004 **CSC_Ca**

Size:	word
Reset Value:	0
Read/Write:	R/W
Description:	Written as 16-bit normalized or un-normalized value. Read back as 8-bit normalized value. Write is held off until there is space or until a timeout occurs. NOTE: Called Cb in CrCb notation.

3F0_0006 **CSC_Cb**

Size:	word
Reset Value:	0
Read/Write:	R/W
Description:	Written as 16-bit normalized or un-normalized value. Read back as 8-bit normalized value. NOTE: Called Cr in CrCb notation.

3F0_0008 **CSC_Y**

Size:	word
Reset Value:	0
Read/Write:	R/W
Description:	Written as 16-bit normalized or un-normalized value. Read back as 8-bit normalized value.

3F0_000A **CSC_AR**

Size:	word
Reset Value:	0
Read/Write:	Read only
Description:	Zero byte and R result value. Read is held off until valid data is available or until a timeout occurs.
Bit(s) 15:8:	0
Bit(s) 7:0:	R value

FIG. 4B

3F0_000C **CSC_GB**

Size: word
Reset Value: 0
Read/Write: Read only
Description: G and B results
Bit(s) 15:8: G
Bit(s) 7:0: B

3F0_0020 **CSC_M11**

Size: 9 bits
Reset Value: 0
Read/Write: R/W
Description: The M11 value (see equations)
Bit(s) 8: sign
Bit(s) 7:0 magnitude

3F0_0022 **CSC_M12**

Size: 9 bits
Reset Value: 0
Read/Write: R/W
Description: The M12 value
Bit(s) 8: sign
Bit(s) 7:0: magnitude

3F0_0024 **CSC_M13**

Size: 9 bits
Reset Value: 0
Read/Write: R/W
Description: The M13 value
Bit(s) 8: sign
Bit(s) 7:0: magnitude

3F0_0026 **CSC_M21**

Size: 9 bits
Reset Value: 0
Read/Write: R/W
Description: The M21 value (see equations)
Bit(s) 8: sign
Bit(s) 7:0: magnitude

3F0_0028 **CSC_M22**

Size: 9
Reset Value: 0
Read/Write: R/W
Description: The M22 value (see equations)
Bit(s) 8: sign
Bit(s) 7:0: magnitude

FIG. 4C

3F0_0030 **CSC_M33**

Size:	9 bits
Reset Value:	0
Read/Write:	R/W
Description:	The M33 value (see equations)

3F0_0033 **CSC_SSR**

Size:	1 bit
Reset Value:	0
Read/Write:	R/W
Description:	Sign of Sr

3F0_0034 **CSC_SR**

Size:	word
Reset Value:	0
Read/Write:	R/W
Description:	Sr value (see equations)

3F0_0037 **CSC_SSG**

Size:	1 bit
Reset Value:	0
Read/Write:	R/W
Description:	Sign of Sg

3F0_0038 **CSC_SG**

Size:	word
Reset Value:	0
Read/Write:	R/W
Description:	Sg value (see equations)

3F0_003B **CSC_SSB**

Size:	1 bit
Reset Value:	0
Read/Write:	R/W
Description:	Sign of Sb

3F0_003C **CSC_SB**

Size:	word
Reset Value:	0
Read/Write:	R/W
Description:	Sb value (see equations)

3F0_003F **CSC_MTXP**

Size:	3 bits
Reset Value:	0
Read/Write:	R/W
Description:	Matrix precision value used to determine amount of final shift (see equations)

FIG. 40

Programming

Setup

Write CSC_CONFIG precision value and normalized flag.

Write CSC_Mxx values

Write CSC_Sx sign and magnitude values

Write CSC_MTXP matrix precision value

Computation

No Pipelining

1. Write Ca value
2. Write Cb value
3. Write Y value (NOTE: always write Y last)
4. Read AR value
5. Read GB value (NOTE: always read GB value last)
6. Write next Y value or CaCbY values
7. Read AR and GB
8. ....

Pipelining

Pipelining will give about 20% improved performance. This requires always keeping one CaCbY value ahead of the ARGB reads as follows:

1. Write Ca value
2. Write Cb value
3. Write Y value (NOTE: always write Y last)
4. Write second CaCbY, or Y-only values
5. Read AR and GB (NOTE: always read GB last)
6. Write CaCbY or Y-only values
7. Read AR and GB
8. ...
9. Read last AR and GB values

FIG.5